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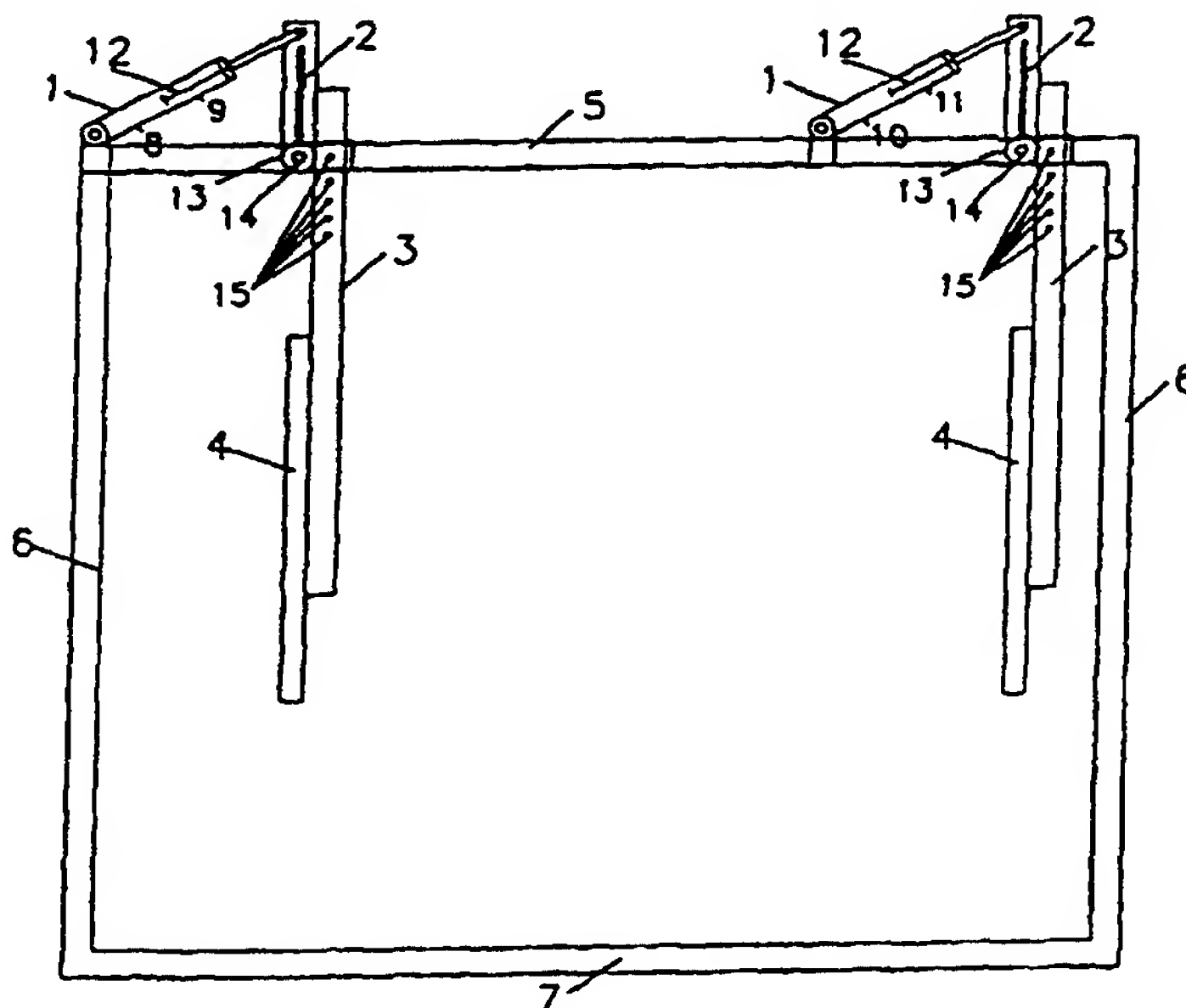
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[Continued on next page]

(54) Title: WAVE POWER GENERATION MACHINE



(57) Abstract: Plant for the production of electric energy from sea waves consisting of a frame carrying two paddles unit, capable of moving successively in series, when driven forward by progressing waves and returning by the gravitation power. Each of said paddles units comprising a rod, to be submerged into sea and said rod is secured on said frame with possibility for pivoting with respect thereof, the lower extremity of said rod terminates by a paddle plate and said paddles units are arranged on said frame in series. Rods are connected to double-acting piston, which charge two accumulators AC1 and AC2 with hydraulic oil. Accumulators transfer oil to hydraulic engine HE that rotates an electric generator G.



WO 02/077447 A1



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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Wave Power Generation Machine

Field of the invention

This invention relates to a plant which uses the energy of sea waves plus the energy of gravitation and converts the energies to electric energy.

Background of the invention

There are different solutions for the production of energy from sea waves, for example, solutions based on wave height, wave movement, etc. The present invention utilizes both the wave length and the wave width by the forward wave power, the backward wave power and the gravitation power with the most efficient way, something that other solutions do not do.

Examples of the innovation inherent in the present invention as compared with the patents enumerated below, both from the point of view of the operating principle and structure, and from the point of view of energy considerations – allowing greater energy to be attained and produced.

1. (i) PCT/IL99/00258 patent request uses for each paddle unit two connecting rods, one above the paddle housing pivot 24 and one below the same paddle housing pivot 24. It is shown in fig 1, fig 5 and fig 6. Each one of the connecting rods is constructed from the components 32+34+40+42 when 40+42 is a piston as it can be shown in fig.2 and fig 3. At the time that a paddle moves forward with the wave movement, the two pistons move, each one as it shown in fig 4. One above the housing pivot 24, pushes oil in the first pump, hydraulic cylinder, as it is shown in fig 4 and the other one, below the housing pivot 24, is pushed by the oil in the second pump, hydraulic cylinder. Afterwards, when the wave leave the paddle, it fall backward with the gravitation power, and again, the two connecting rods move in the other direction. In the patent request PCT/IL99/00258, there are energy losses of two connecting rods, each one is: 32+34+40+42. The losses is in the connections: between 32 and 34, between 34 and 40 and between 40 and 42 as it shown in fig 2 and fig 3 during the time of each connecting rod movement as it shown in fig 4, and energy losses of two hydraulic cylinders for each paddle movement. Plant with, for example, 10 paddles between two waves (The target is to have the most energy. The sum of the energy in all the paddles between two waves is the plant's energy. A plant with many paddles between two waves produces a lot of energy.), there are a lot of energy losses: energy losses of 20 connecting rods in forward paddles movements plus energy losses of 20 connecting rods in backward paddles movement. Together is an energy loss of 40 connecting rods. For example, energy losses of one connecting rod is 5% (0.05). The energy losses of 40 connecting rods is 20% ($0.05 \cdot 40 = 0.2 = 20\%$), than the system has efficiency of 80%.

The present invention uses one connecting rod that include one piston inside one hydraulic cylinder for each paddle unit. Each piston is a two-direction piston, in the two ways of a paddle movement, backward and forward. The piston pushes oil inside one hydraulic cylinder in two ways, pushes oil to both directions, with paddle movement forward and backward. This brings to minimum energy losses,

esecially it expressed in a plant with many paddles for example plant with 10 paddle has energy losses of 10 connecting rods in each direction, together energy losses of only 20 connecting rods. For the same above example, energy losses of one connecting rod is 5% (0.05). The energy losses of 20 connecting rods is 10% ($0.05 \times 40 = 0.2 = 20\%$), than the system has efficiency of 90%.

The above explanations show that plant with 10 paddles in the present invention has an energy loss of 20 connecting rods with efficiency of 90%, and in PCT/IL99/00258 patent request, energy losses of 40 connecting rods with efficiency of 80%.

The present invention produces energy in the most efficient way.

(ii) PCT/IL99/00258 patent request shows in the application - page 5 paragraphs 4,6, and 7, that the invention has one rod with two pistons with two hydraulic cylinders, both of them send the oil to **one** accumulator. It is theoretical, in realaty the only way that accumulator can be filled by hydraulic cylinders is, one by one. The hydraulic cylinders above the paddle rod operated one by one and the hydraulic cylinders below the paddle rod operated one by one also, but all the hydraulic cylinders, above and below paddle rod, don't operated one by one. In this way the accumulator can't be filled and work properly. The PCT/IL99/00258 patent request can be used only to produce energy up to the accumulator. The accumulator should send oil to hydraulic engine that operates the generator. The PCT/IL99/00258 patent request can't make a progress from the accumulator to the generator, because the accumulator does not work. The PCT/IL99/00258 patent request can produce energy but can not produce **electric** energy becuaese it uses one accumulator.

In the present invention, there are **two** accumulators. All pistons oil exit in the first direction, fill the first accumulator with oil one by one, when the paddles move forward, and all pistons oil exit in the second direction, fill the second accumulator with oil one by one when the paddles move backward. This invention can be used to produce electric energy with two accumulators that send the oil to hydraulic engine that rotates the generator.

(iii) PCT/IL99/00258 patent request claims don't say that in backward paddle unit motion, after a wave leave the paddle's plate and the paddle fall pivoting with its gravitation, this paddle energy is not utilized. The only energy that utilized is the energy of a wave that hits the paddle's plates. The gravitation energy of each paddle isn't utilized.

The present invention shows in claim 1 that either, in forward paddle unit motion, the paddle's energy is accepted and consumed and, in backward paddle unit motion, the paddle's energy is accepted and consumed.

2. (i) US patent 5084630 utilizes:

Only the width of the wave and not the length thereof. In this patent there is disclosed a system consisting of number of units provided with paddles for each section of wave width. At the bottom of each paddle there are plates. The plates are spaced laterally one from another relative to the direction of

wave movement. Each paddle activated a pump. In this way, the wave power is not sufficient utilizes because after the wave strikes the paddle and leave it, it continues to advance and is not longer in contact with the paddle. Hence, the wave's power is not fully utilized. The system disclosed in US patent 5084630 utilizes variations in sea level. For this purpose it is provided with a dedicated subsystem, including a set of separate pumps. Due to this provision the whole system is complicated as it requires additional control means for coordination of the paddle disposition with the variation in sea level. Furthermore, as the disposition of the paddle is continuously changed and the paddle is not submerged deeply enough to maximally utilize available energy, it is not possible to utilize the energy of those wave components, which move, under the wave.

The present invention utilizes:

Most efficiently both the length and the width of the wave in the following way:

The lower extremities of the paddles are parallel to the wave width. They are arranged one after other in such a way that from a top view, they are arranged in series. Then, when the wave strikes the lower extremity of the first paddle it continues to move, and also strikes the other paddles, until the wave is flattened. In this way, the power of the wave is consumed in a most efficient so as to get maximum energy from the wave. The energy of the next wave coming after the first wave will be utilized in a similar way.

(ii) US patent 5084630 utilizes:

Only the energy in one direction of each paddle. When a paddle, 66+68+70+82+84 as it is shown in figs 3-7, moves pivotal forward, the piston 124+128 as it is shown in fig 8, pushes oil within hydraulic cylinder 130 to give the energy to the generator 196, through 188, 146 and accumulator 140. The oil comes from hydraulic tank 208 through pipe 210. When the paddle return backward after the wave leave the paddle, the piston 124+128 return back and press some air and/or oil if desire back to the tank 208 through inlet pipe 212. The accumulator 140 does not get oil and the generator 196 does not get energy. The US patent 5084630 has a one direction piston. The patent uses the paddle energy in one direction, when the paddle move forward with the wave, in the other paddle direction, the patent does not utilize the paddle's energy.

The present invention utilizes:

The whole paddle energy. The invention has for each paddle, two-direction piston. When a paddle move forward with the wave, the piston inside the hydraulic cylinder, pushes oil to the first accumulator, after the wave leave the paddle, it return backward and the same piston pushes oil to the second accumulator. The two accumulators send the oil through pipes to an hydraulic engine that rotates a generator. The present invention receive energy from both paddle movements pivotal forward and pivotal backward.

3. Patent GB 384603A has one crankshaft mechanism for the whole paddles.

The energy consideration is:

The power of each wave is known on the basis of the wave's height and width. The wave strikes the first paddle, the second paddle, the third paddle and so forth, until the wave completely flattens, and then the next wave comes along. Just like an accumulator that is depleted, so the system takes all the power minus losses.

In General:

The total energies of all paddles situated
in series between two wave

$$\frac{\text{-----}}{\text{Time between two waves}} = \text{Plant Power}$$

The mathematical principle of calculating the wattage:

P - The power as calculated according to its height and breadth.

μ - Paddle efficiency.

N - Number of paddles.

Number of Paddles (N)	Wave power before the Nth Paddle	Paddle Power
1	P	$P * \mu$
2	$P - P * \mu$	$(P - P * \mu) * \mu$
3	$(P - P * \mu) - (P - P * \mu) * \mu = P(1 - \mu)^2$	$P(1 - \mu)^2 * \mu$
:	:	:

Thus, the series continues, so that the greater the number of paddles, the greater the system power, up to the maximum P.

The rod that links the last paddle to the crankshaft mechanism in Patent GB 384603A is extremely long because of the distance between one wave and another.

In order to obtain maximum power, it is necessary to provide at least 15 paddles. When the waves are 2 meters to 5 meters high, the distance between two waves is 50-100 meters (so that said rod must also be 50-100 meters!)

Because such a great rod length is required, the profile of the rod proposed in GB 384603A is extremely thick and large, so that it should not bend under the force of the waves, and quite impractical.

Because of the weight of the rod proposed in GB 384603A, and the slow wave speed prevailing under said conditions, it is not possible to attain the minimum speed of 500 rpm required to rotate the flywheel of the oil pump (linked to the accumulator that drives an oil engine, which in turn drives a generator and produces the electric energy).

Thus, it should be emphasized, that the arrangement proposed in GB 384603A is completely impractical where waves higher than 2 meters are concerned.

Thus, GB 384603A is only applicable when waves are small and the distance

between one waves and another is short. Where higher waves are concerned, the entire plant proposed by GB 384603A becomes dysfunctional and cannot be used to attain high capacities.

The present invention has crankshaft mechanism of each paddle unit, without uses a rod to link among the paddles. Each paddle unit operated independently.

My own invention, as described in the application, is equally practicable in both small and large waves and can be used to obtain high power capacities under both sea conditions, and this is the technological innovation of my patent application over GB 384603A.

4. US patent 5244359 describes a marine energy converter system based on utilization of differences in sea level which it converts into linear movement only of piston 21 which moves within its casing 17. The casing 17 is rigidly connected with pole 3 which is anchored at the bottom of the sea. The above converter can only exploit linear movement, and does not make it possible to exploit the dynamic energy of the sea waves. The above converter is equipped with a floating system piston. The piston is connected to a float 41 and this enables the linear movement of the piston within the piston casing. As a result the piston, within its casing by virtue of the rising level of water, requires very little force to rise. However, since energy is always a product of force multiplied by distance, the resultant energy is very small as a consequence of the small amount of force exerted.

The present invention, however, is based on a different principle, i.e., the exploitation of the dynamic energy of sea waves, which gives rise to pivotal movement of the paddles rather than their elevation. The pivotal movement is subsequently converted into linear movement of the piston by means of a crankshaft mechanism 32,40. The piston rises within the casing with relatively great force and the energy produced is thus greater.

Thanks to the structure of the system according to the present invention, it is possible to utilise wave regardless of the height of the wave itself.

Both from the point of view of the present invention's operating principle and from the point of view of its particular structure, the US 5244359 energy converter is not similar to the present invention.

5. US Patent 4843249 describes a hydroelectric system, which utilizes the movement of the waves and converts them into circular movement. Said system includes a turbine 22 whose vanes are moved by the moving wave. The turbine wheel is connected to equipment for the generation of electrical energy.

The present invention, by comparison, does not convey circular energy, but rather utilizes the axial movement of the paddles to move the piston in a linear motion.

As in the previous case, the above US patent does not void the innovation or the innovation of the present invention, neither in principle nor from the point of view of the structure of the above – described patent.

It may also be noted, that the utilization wave energy in order to create circular energy along, is inferior to the creation of linear motion, on the following counts: In order to achieve better than 90% utilization, for example, a pump activated through circular energy must rotate at speeds of 500-5000 rpm. Below 500 rpm, the efficiency rate is abruptly reduced to about 40%. In order to attain such high speeds, when the wave movement is relatively low, it is necessary to provide additional transmission by means of a few pairs of cog-wheels, thus creating losses in the system. Moreover, if we introduce a number of pairs of cog-wheels, then the total efficiency of the system is reduced, and the energy produced is thus far lower. The cost of the system too, is increased through the provision of many pairs of additional cogwheels.

However, when the piston moves in a linear motion, the immediate efficiency of the system is at least 90% and a linear pump or linear motor are not limited by any constraints.

6. US Patent 53311064 describes a system for generating energy from the movement of sea waves, based on a similar principle to that of the above described hydro-electric system, i.e., the use of a turbine which is rotated by the flow of water. The circular movement is conveyed to the energy generating mechanism by means of a transmission mechanism.

All the above given explanations regarding the hydro-electric system according to US patent No. 4843249 is also valid in this case, both as regards circular motion versus linear motion and the differing structure.

7. Fr Patent 501795 described a system for generating energy from the movement of sea waves.

- (i) The system has one paddle. The lower extremity of the paddle's plate is a buoy that moves vertically up and down when the wave reaches the plate. The paddle receives only the high energy from the wave.

When a wave hits a paddle, the paddle goes up in pivotal movement. In this way each paddle receives from the wave high energy plus kinetic energy. The present invention receives from each paddle much more energy from the above Fr Patent 501795.

- (ii). The present invention has **at least two paddles**. The Fr Patent 501795 has **one** paddle. The advantage of the present invention from this reason is the same as explained in the above 2(i) towards US patent 5084630.

Brief description of the drawings

Fig 1. Is the invention's view, showing the positions of two paddles and their pistons before hit by a wave.

Fig 2. Is the invention's view, showing the positions of two paddles and their pistons driven by a wave.

Fig 3. Shows a side view of the system in accordance with the present invention.

Fig 4. Shows a top view of the system in accordance with the present invention.

Fig 5. Is the two-direction piston inside hydraulic cylinder that connected to two accumulators.

Fig 6. Shows a paddle's plate in the sea.

Detailed description of the preferred embodiment

With reference to fig 1, the system in accordance with the present invention comprises a support structure 7 consisting of legs 6 carrying an upper frame 5. The legs are anchored in the sea floor.

On the upper frame there are mounted at least two paddle units, which will be described in more detail later on, Each paddle unit comprises a paddle rod 3 connected to a housing 13. Within the housing there is mounted an axle 14, which is rigidly secured to the upper frame.

Each paddle unit comprises a paddle rod 3 rigidly connected to the housing 13. The housing is mounted around an axle 14, secured to the upper frame 14. A rotational movement of the housing with respect to the axle is accomplished by virtue of a pivotal movement of the paddle rod 3 with the plate 4, driven by a wave.

The lower extremity of the paddle rod 3 is terminated by a paddle plate 4, which encounters the wave and is driven thereby. The height of the legs 6 and also the distance between the upper frame 5 and the sea level SL is chosen in such a manner that the main portion of the paddle plate 4 is submerged under sea level, while the upper part of the paddled plate 4 thereof is situated above to the sea level SL as can be seen in fig 6. By virtue of this disposition it is possible to utilise the energy of the wave approaching the paddle plate not only below sea level but also above.

In contrast to the known system described in US 5084630, where the energy of a wave broken by the paddle is not consumed fully, as the wave continues to move freely, in the present invention all paddle units are arranged in series. By virtue of this arrangement the energy of a wave after it has been broken by a leading paddle unit will be consumed by a successive paddle unit.

Due to this arrangement the energy of approaching waves is consumed in most efficient way.

With reference to fig 1 and fig 2 one can see different stages of a pivotal moving paddle units driven by a wave entering the system. The piston rods 12 move inside hydraulic cylinders 1, with the paddles motion. In the forward paddle motion the piston rods press oil to the first accumulator via pipes 8 and 10 and in the backward paddles motion the piston rods press oil via pipes 9 and 11 to the second accumulator.

In practice for a sea floor depth of 3m and a wave height of 1m (defined as: 0.5m above sea level and 0.5m below sea level) the following paddle dimensions may be recommended: the length of the paddle rod can be 5.5m, the height of the paddle plate

can be 0.5m-3m, the width of the paddle plate can be 2m, and the distance D can be 1m. If the dimensions are given as above, the distance between two paddle units belonging to the same system should be 1m – 1.5m.

With reference to fig 3, the system in accordance with the present invention comprises a support structure 7 consisting of legs 6 carrying an upper frame 5. The legs are anchored in the sea floor. The paddle rods 3 are hang on the upper frame. The support arms 16 and 17, strenght the paddle plate. The fig 3 shows that part of the paddle plate is located above the sea level SL and part below.

Now with reference to figs 1,2,4 it will explained how the pivotal movement of the paddle rods, driven by sea waves is transferred into energy.

As shown the housing 13 is rigidly connected with an intermediate rod 14, which terminates with part 2.

It can be readily understood that the combination of elements 2,12 constitutes a common crank shaft mechanism, which the pivotal movement of the transforms paddle rod 3 into a linear reciprocating motion of the piston rod 12.

It is not shown specivically, but should be understood that the hydraulic cylinder is connected with an appropriate means for utilizing the flow of hydraulic flued in both directions via the fluid ports.

In operations, the sea waves successively approach the first paddle unit and then the second paddle unit and thus cause pivotal movement of each paddle rod.

Each paddle unit is provided with a dedicated crank shaft mechanism transforming this movement into a linear motion of the corresponding piston supplying hydraulic fluid from the corresponding cylinders 1 to two accumulators AC1 and AC2. Hydraulic fluid exits the accumulators and actuates an hydraulic engine, which drives a generator.

With reference to fig 4 one can see that, in all forward piston rods 12 motion inside hydraulic cylinders 1, the oil is transfered through pipes 8 and 10 to the first accumolator AC2, and in all backward piston rods 12 motion inside hydraulic cylinders 1, the oil is transfered through pipes 9 and 11 to the second accumolator AC1. The accumulators AC1 and AC2 transfer the oil to hydraulic engine HE, and the hydraulic engine rotates the generator G, which produces electric energy.

Both extremities of the piston rod 12 are connected to the hydraulic cylinder 1. By virtue of this arrangement it is possible to increases the amount of power produced by the same paddle unit. With reference to fig 5 it is shown how each one of the piston rods 12 moves inside two direction hydraulic cylinder 1, and respectively are actuated by the paddle rods of each unit. All hydraulic cylinders 1 are connected to two accumulators AC1 and AC2 as in the previous embodiment. The oil is sent from the tank oil throgh 18 and 20 and valves 23 in these pipes let the oil to move only in one way, to enter to the hydraulic cylinder 1. The oil return to the tank oil TO through pipes 19 and 21. The valves 23 in these pipes, let the oil to move only in one way, to exit from the hydraulic cylinder1. Oil pressure taps 22 are for generating resistance

while oil moves to the accumulators AC1 and AC2. At the time that the piston rod 12 moves to the right side, backward, an oil is entered from the tank oil TO through pipe 18 to the hydraulic cylinder 1, and an oil is pressed by the piston rod 12 to the accumulator AC2 while part of it returns to the tank oil TO through pipe 21. Afterwards, at the time that the piston rod 12 moves to the left side, forward, an oil is transferred from the tank oil TO through pipe 20 to the hydraulic cylinder 1, and an oil is pressed by the piston rod 12 to the accumulator AC1 while part of it returns to the tank oil TO through pipe 19.

The other important feature of the system in accordance with the present invention is position of paddle plate 4 with respect to the sea floor that can be change according to a time scale.

With referecne to fig 6 the distance between the lower extremity of paddle plate 4 and the sea floor is designed by D, can be changed according to a time scale, i.e. every 10 minutes the paddles go up 10 cm.

With reference to Fig 6 and Fig 1: It has been found empirically that changing the distance D between the lower extremity of paddle plate 4 and the sea floor SF, helps utilise the energy of a wave W approaching the paddle plate, in the most efficient way at tide time. At that time, the paddle rods 3 can be move up by changing the position of the connections 15, between 3 and 2 according to a time scale, i.e. every 10 minutes the paddle rods move up 5 cm. Half of the wave height is above sea level SL and half is below. The paddle plate 4 gets energy from all the wave hight as all the wave hits the plate.

CLAIMS

1. A system for producing energy from sea waves, said system comprising a frame carrying at least two paddle units, said paddle units are movable by progressive waves, each of said paddle unit comprising a rod, to be submerged into sea and said rod is secured on the frame with possibility for pivoting with respect thereof, the lower extremity of the rod terminating by paddle plate, said paddle units reside on the frame in such a manner that the adjacent paddle plates are arranged in series and accordingly accept and consume the energy of progressive wave successively, wherein, each of said paddle unit is provided with a dedicated transfer means for converting reciprocate pivoting motion of the paddle unit into electric energy, said transfer means comprising a crankshaft mechanism mounted on the frame with possibility to be driven by the rod and with a piston actuable by the crankshaft mechanism, said crankshaft mechanism causes that either, in forward paddle unit motion, the paddle's energy is accepted and consumed and, in backward paddle unit motion, the paddle's energy is accepted and consumed.
2. The system as defined in claim 1, in which said rod moves inside two-direction piston. In the first direction of the piston rod motion, an accumulator is being filled with oil, and in the second direction of the piston rod motion, another accumulator is being filled with oil.
3. The system as defined in claim 2, in which said paddle units are secured on the frame in such a manner that the distance between the lower extremities of paddle plates and the sea floor can be change according to a time scale.
4. The system as defined in claim 3, comprising adjustment means for adjusting the disposition of the paddle plates substantially perpendicularly to the direction of movement of progressive waves.

AMENDED CLAIMS

[received by the International Bureau on 15 January 2002 (15.01.02);
original claims 1-4 replaced by new claims 1-3 (1 page)]

1. A system for producing energy from sea waves, said system comprising a frame carrying at least two paddle units, said paddle units move in pivotal motion when they are hit by progressive waves, each of said paddle unit comprising a rod, to be submerged into the sea and said rod is secured on the frame with a possibility for pivoting with respect thereof, the lower extremity of the rod terminating by paddle plate, said paddle units residing on the frame in such a manner that the adjacent paddle plates are arranged in series and accordingly accept and consume the energy of progressive wave successively, wherein, each of said paddle units is provided with a dedicated transfer means for converting reciprocate pivoting motion of the paddle unit into electric energy, said transfer means comprising a crankshaft mechanism mounted on the frame with the possibility of being driven by the rod and with a piston actuated by the crankshaft mechanism, said crankshaft mechanism causing that both, in forward paddle unit motion, the paddle's energy is accepted and consumed through one hydraulic motor and, in backward paddle unit motion, the paddle's energy is accepted and consumed through the same hydraulic motor.
2. The system as defined in claim 1, in which said rod moves inside a bi-directional piston. In the first direction of the piston rod motion, an accumulator is filled with oil and it forwards the oil to one hydraulic motor, and in the second direction of the piston rod motion, another accumulator is filled with oil and it forwards the oil to the same hydraulic motor.
3. The system as defined in claim 2, in which said paddle units are secured on the frame in such a manner that they move, at a tide time, in vertical motion while been supervised, to find the optimum fix position of the paddle's heights, said paddle's heights stay in this position even when the sea water continues to move up and down with the tide.

STATEMENT UNDER PCT ARTICLE 19(1)

Claim 1 of the above application has been amended for two objectives:

1. To incorporate the features referring to the paddles units that move in pivotal motion when they are hit by progressive waves and each paddle operates hydraulic cylinder, while in JP patent 006750 there is a float that moves vertically up and down with the waves, and the float operates hydraulic cylinders with this movement.

JP patent 006750 converter can only exploit linear movement, and does not make it possible to exploit the dynamic energy of the sea waves. The hydraulic cylinders, 2 and 2a, are pistons connected to a float 1 and this enables the linear movement of the pistons within the piston casing. As a result the pistons within the casing, by virtue of the rising level of water, require very little force to rise. However, since energy is always a product of force multiplied by distance, the resultant energy is very small as a consequence of the small amount of force exerted.

The present invention, however, is based on a different principle, i.e., the exploitation of the dynamic energy of sea waves, which give rise to pivotal movement of the paddles rather than their elevation. The pivotal movement is subsequently converted into linear movement of the bi-directional piston by means of a crankshaft mechanism 32,40. The piston rises within the casing with relatively great force and while the energy produced is a product of force multiplied by distance, the resultant energy is higher as a consequence of the high amount of force exerted. Thus the energy produced according this system is greater than JP patent 006750.

2. To show that the system has one hydraulic motor that works with all kinds of oil pressure while in US patent 4,490,621 there are two hydraulic motors 121a and 121b with a complicated system. When the oil pressure $P_{1a} > P_{1b}$, the first hydraulic motor 121a works and when the oil pressure $P_{1a} < P_{1b}$, the second hydraulic motor 121b works.

Claim 2 of the above application has been amended to show the use of bi-directional piston with one hydraulic motor in the present invention while the piston in US patent 4,490,621 which is, double acting piston, requires two hydraulic motor.

Claim 3 in this application has been amended to incorporate the features referring to the supervised paddle movements in vertical motion at tide time to find the optimum paddle's height for making maximum system's energy production. The product of a paddle's height by the wave's force is the momentum. The product of the momentum by the paddle's velocity is the paddle's power. The sum of all the paddle's powers between two waves is the system's power. The system's energy is maximum when the paddle heights are in optimum position. The above operation shows the difference to the US patent 1,960,622. The above optimum distance in the US patent 1,960,622 does not established to make maximum energy, since the rod 20 and the plate 25 move upwards or downwards synchronously, automatically, but not supervised, with the movements of the sea level at the tide time.

The paddles's system according to the present invention stays in the optimum fixed position even when the sea water continues to move upwards and downwards with the tide, while in the US patent 1,960,622, the rod 20 and the plate 25, move upwards or downwards all the time with the sea water at the tide time.

The operation according to claim 3 of the present invention is not used in US patent 4,490,621.

Both from the point of view operation principle of the present invention and from the point of view of its particular structure, the patents JP 006750, US 4,490,621 and US 1,960,622 energy converters are not similar to the present invention.

The introduced amendmends do not go beyond the disclosure in the above application referred as filed, they do not introduce any new matter and there is no impact on the description and the drawings.

None of the references cited in the search report comprises a combination of the features as defined in the amended claims and therefore the applicant respectfully

requests reconsideration of the characterization of the references during Chapter II examination.

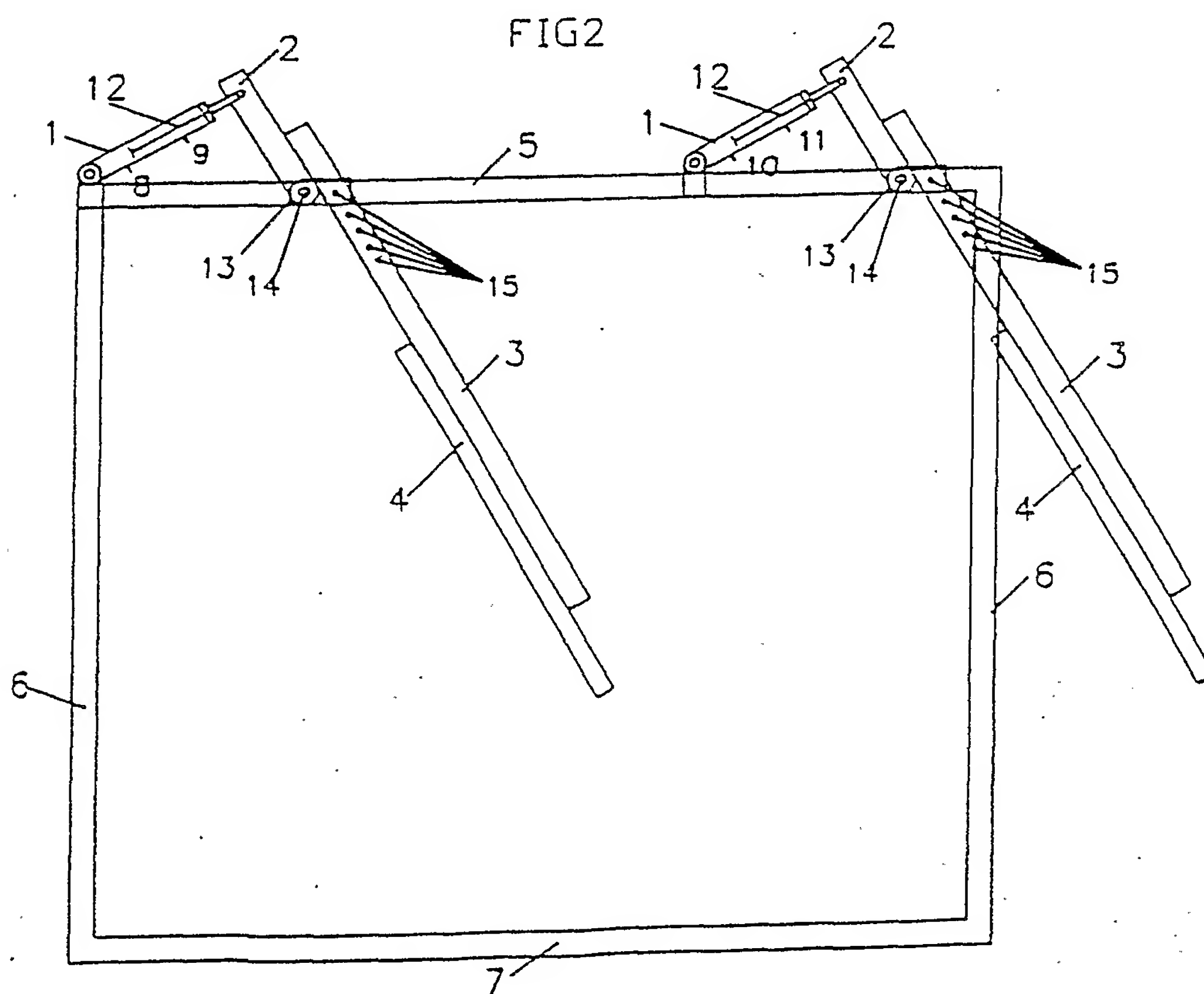
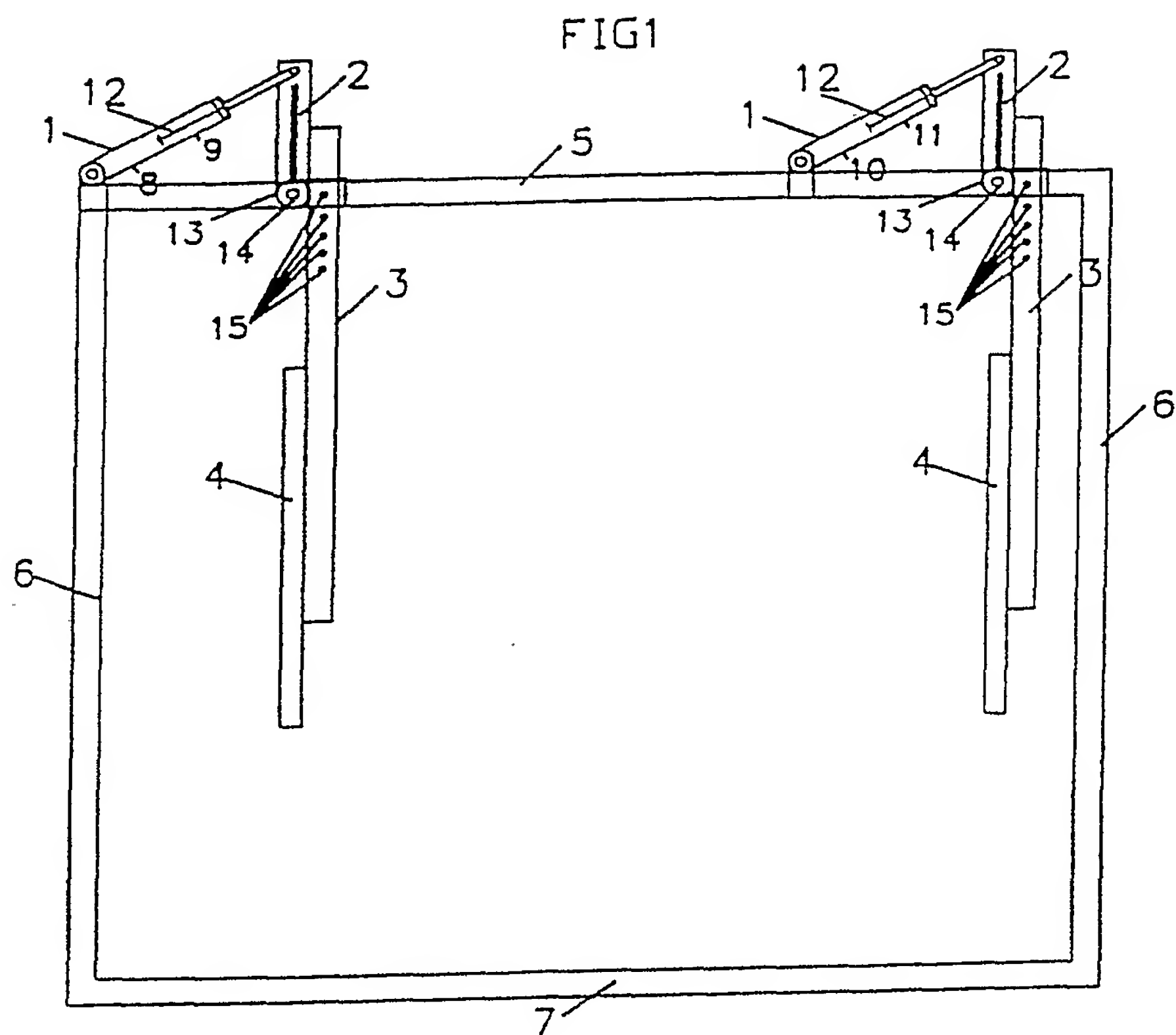


FIG3

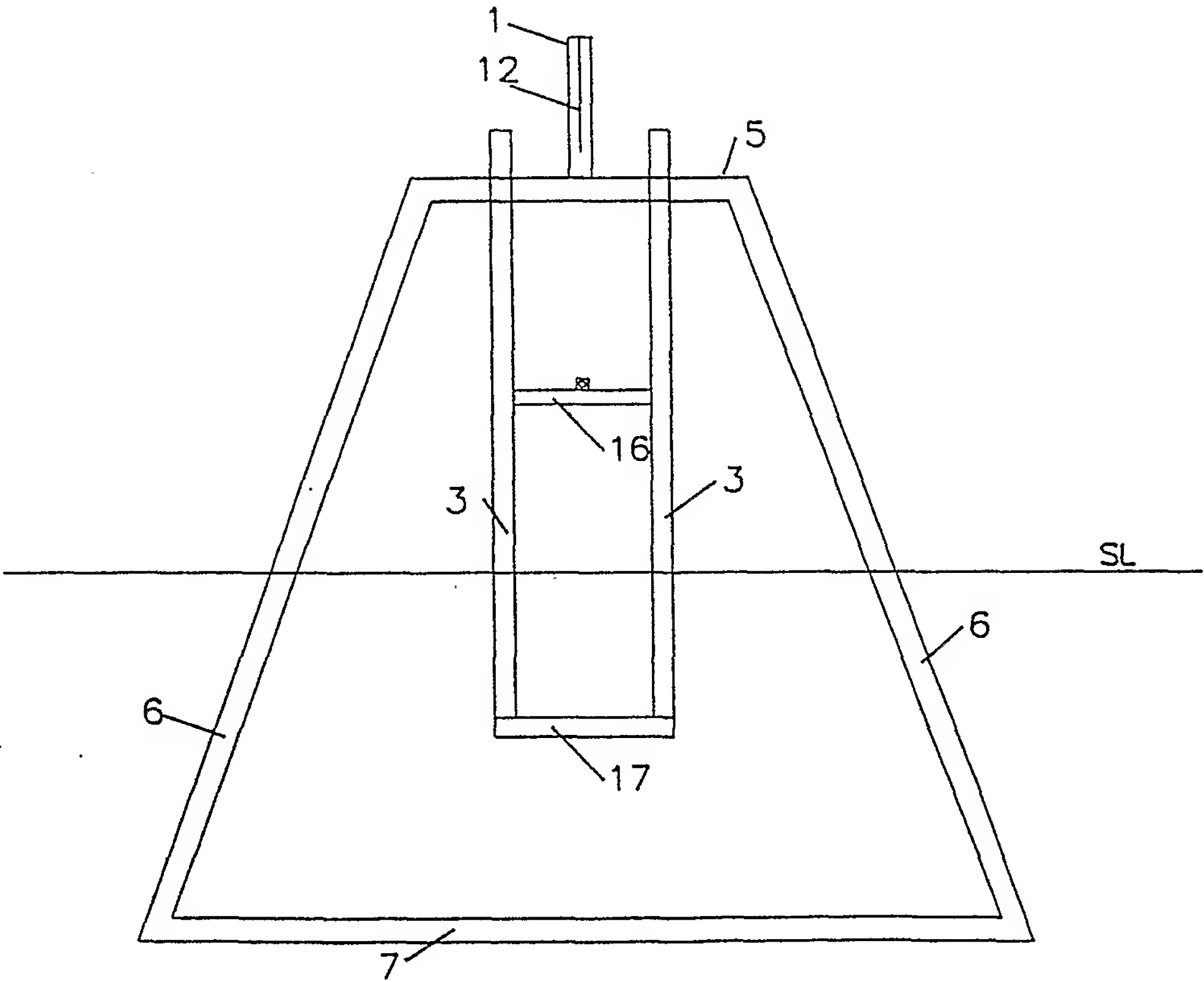


FIG4

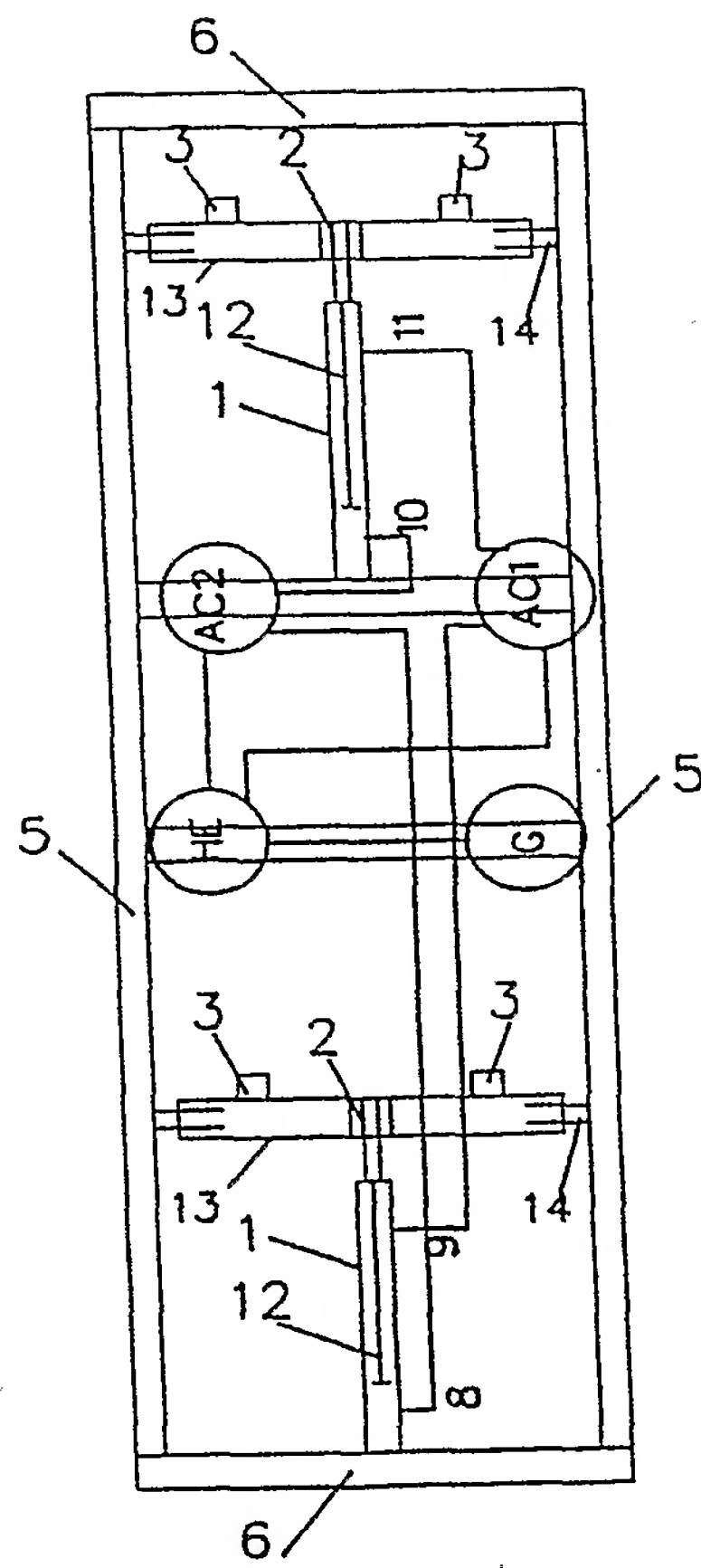


FIG5

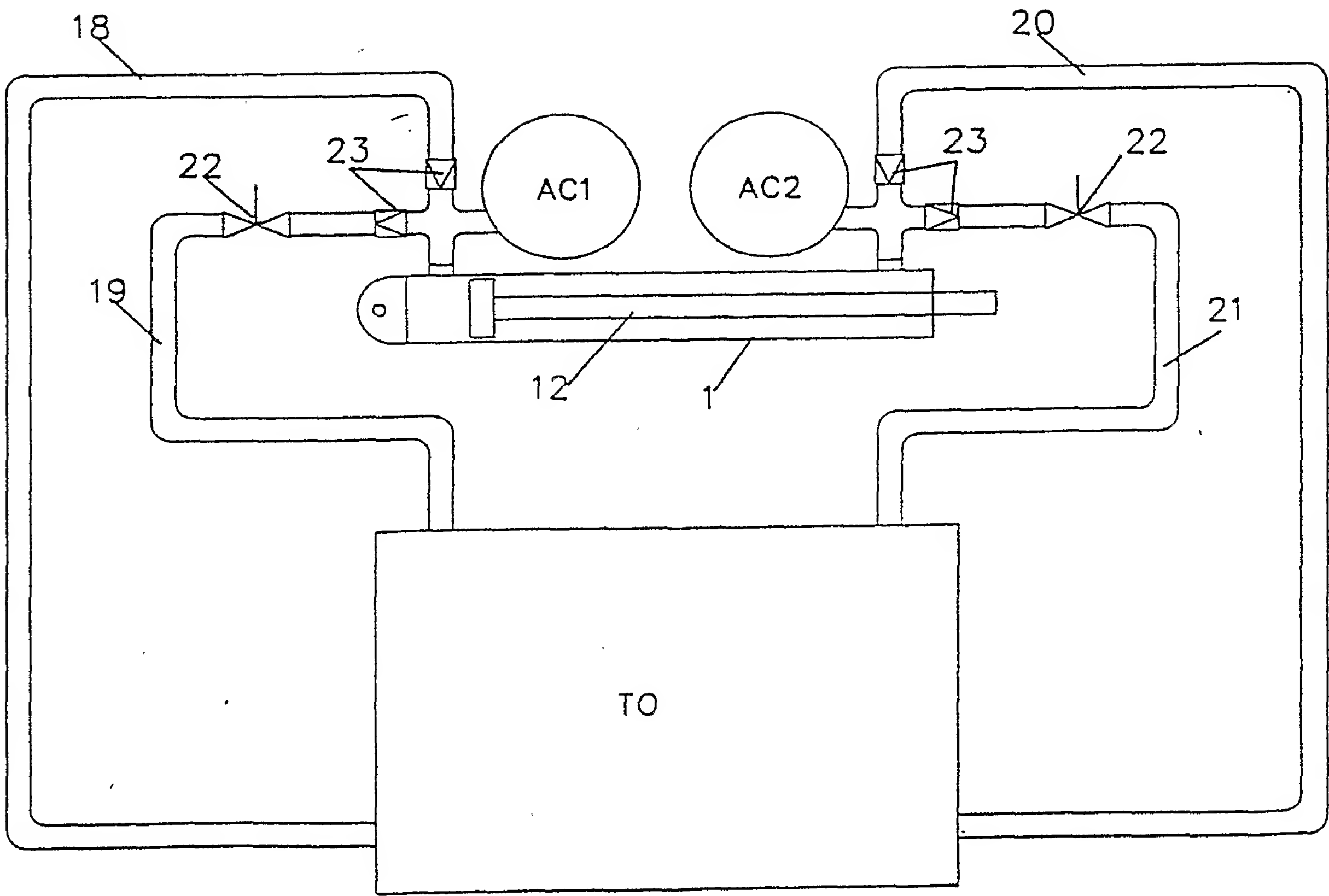
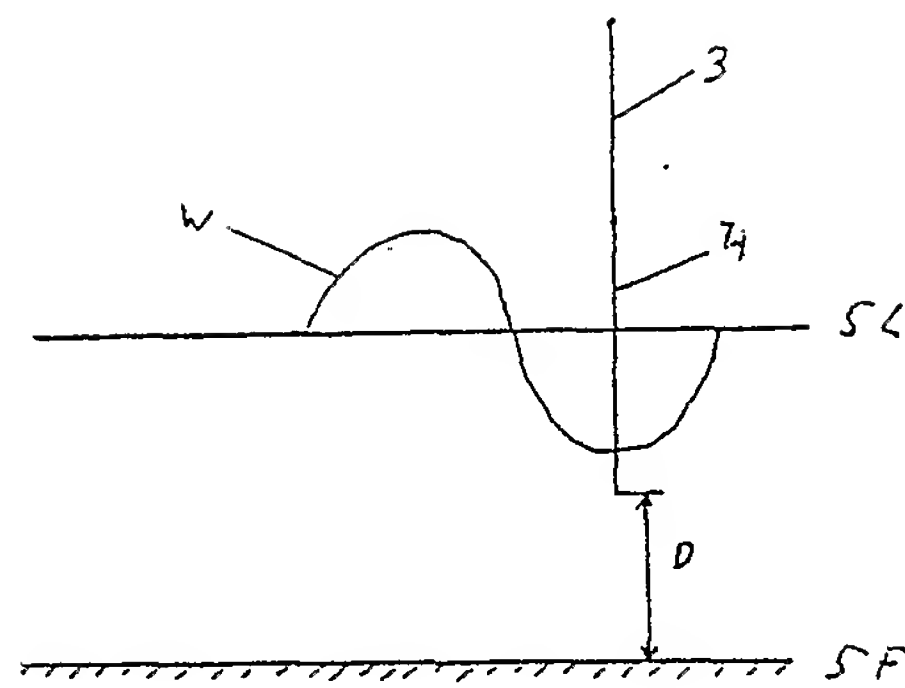


FIG6



INTERNATIONAL SEARCH REPORT

Inte al Application No

PCT/IL 01/00271

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 F03B13/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 F03B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 490 621 A (WATABE TOMIJI ET AL) 25 December 1984 (1984-12-25)	1,2
Y	column 4, line 59 - column 5, line 16 figure 4	3,4
Y	US 1 960 622 A (DU PONT ANTHONY W) 29 May 1934 (1934-05-29) page 1, line 39 - line 50 page 2, line 1 - line 90 figures 1,5	3,4
A	DE 120 130 C (SCHNECKENBERG) 5 November 1899 (1899-11-05) page 1, left-hand column, line 27 -right-hand column, line 11 figure 4	3,4
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☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

° Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
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- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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- * & * document member of the same patent family

Date of the actual completion of the international search

5 November 2001

Date of mailing of the international search report

26/11/2001

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INTERNATIONAL SEARCH REPORT

Int. Patent Application No.

PCT/IL 01/00271

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	FR 653 953 A (HANDYSIDE CHARLES-HENRY) 29 March 1929 (1929-03-29) page 1, line 58 -page 2, line 12 page 3, line 6 - line 16 figures 1,3 ----	1-4
A	FR 621 775 A (SCALESSE) 17 May 1927 (1927-05-17) the whole document ----	1-4
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